Find The Area Of A Regular Hexagon With A Said Length Of 10 Centimeters And A Apothem Of 5 Spuare Root

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Understanding how to calculate the area of a regular hexagon is an essential skill in geometry, especially in fields involving design, architecture, and various engineering disciplines. A regular hexagon is a six-sided polygon with all sides and angles equal, making it a symmetric and aesthetically pleasing shape. In this article, we will explore the step-by-step process to find the area of a regular hexagon when given the side length of 10 centimeters and an apothem of 5√(5 times the square root). We will delve into the relevant formulas, clarify the key geometric concepts involved, and demonstrate how to perform the calculations accurately.

Understanding the Components of a Regular Hexagon

Before proceeding to the calculation, it's crucial to understand the fundamental components of a regular hexagon:

1. Side Length (s)

- The measure of each side of the hexagon.
- In our case, s = 10 centimeters.

2. Apothem (a)

- The perpendicular distance from the center of the hexagon to the midpoint of any of its sides.
- It serves as the radius of the inscribed circle within the hexagon.
- Given as a = 5√(which is 5 times the square root of a number, typically written as $5\sqrt{x}$).

3. Radius (R)

- The distance from the center to any vertex of the hexagon.
- Related to the side length and apothem through specific geometric relationships.

4. Area (A)

- The total surface area enclosed within the hexagon.

Understanding these components helps us apply the correct formulas and ensures accurate calculations.

Key Geometric Relationships in a Regular Hexagon

The calculation of a regular hexagon's area relies on well-established geometric relationships:

1. Relationship Between Side Length and Radius

- For a regular hexagon, the radius (R) from the center to a vertex is equal to the side length:

$R = s$

- Therefore, in our case:

$R = 10$ centimeters

2. Relationship Between Apothem and Side Length

- The apothem (a) is related to the side length (s) by the formula:

$a = (s \sqrt{3}) / 2$

- Conversely, if the apothem is known, the side length can be derived:

$s = (2 a) / \sqrt{3}$

3. Area Formula for a Regular Hexagon

- The most straightforward formula to find the area is:

$A = (3 s a) / 2$

- Alternatively, the area can be computed using the apothem and the perimeter:

$A = (\text{Perimeter apothem}) / 2$

where Perimeter (P) = 6 s

- These formulas are consistent and interchangeable, provided the side length and apothem are correctly related.

Calculating the Area of the Hexagon

Let's proceed step-by-step to compute the area with the provided data:

Step 1: Confirm the Given Data

- Side length: s = 10 cm
- Apothem: a = 5√ (assuming the actual value is 5√x, but since no specific number is given, we'll interpret as a = 5√x)

However, the problem states "a Said Length Of 10 Centimeters And A Apothem Of 5 Spuare Root" — which seems to be a typo or misstatement. The phrase "5 Spuare Root" probably indicates "5√" followed by a number or simply "5√" as an expression of the form 5√x.

Assumption: The apothem is given as 5√x, where x is a specific number. For the sake of clarity, let's interpret it as a = 5√3, which aligns with the standard geometric relationship in a regular hexagon:

$a = (s \sqrt{3}) / 2$

Given s = 10 cm,

$a = (10 \sqrt{3}) / 2 = 5 \sqrt{3}$

Thus, the apothem is 5√3 centimeters.

Step 2: Verify the Consistency of the Data

- Using the formula for the apothem:

$a = (s \sqrt{3}) / 2$

Plugging in s = 10:

$a = (10 \sqrt{3}) / 2 = 5 \sqrt{3}$

- The provided "apothem of 5√" matches this value, confirming our assumption.

Step 3: Apply the Area Formula

- The formula:

$A = (3 s a) / 2$

- Substituting $s = 10$ and $a = 5\sqrt{3}$:

$A = (3 \ 10 \ 5\sqrt{3}) / 2$

Simplify numerator:

$3 \ 10 \ 5\sqrt{3} = 150\sqrt{3}$

- Divide by 2:

$A = (150\sqrt{3}) / 2 = 75\sqrt{3}$

Step 4: Express the Area in Exact and Decimal Form

- Exact form:

$A = 75\sqrt{3}$ square centimeters

- Approximate decimal value:

Since $\sqrt{3} \approx 1.732$,

$A \approx 75 \ 1.732 \approx 129.9$ square centimeters

Final Result:
The area of the regular hexagon is approximately 129.9 square centimeters, or exactly $75\sqrt{3}$ square centimeters.

Additional Insights and Applications

Understanding the area of a regular hexagon has numerous practical applications:

1. Architectural Design

- Hexagonal tiles are popular in flooring and wall designs.
- Knowing the area helps in estimating quantities needed.

2. Engineering and Manufacturing

- Hexagonal components are used in various machinery and structures.
- Precise area calculations assist in material estimation and structural analysis.

3. Nature and Biology

- Hexagonal patterns are prevalent in nature (e.g., honeycombs).
- Analyzing these patterns involves similar geometric principles.

Summary of Key Formulas

To summarize, here are the essential formulas used in calculating the area of a regular hexagon:

- Side length to apothem: **a = (s √3) / 2**
- Area from side length and apothem: **A = (3 s a) / 2**
- Perimeter: **P = 6 s**
- Area using perimeter: **A = (P a) / 2**

Note: Always ensure the data provided is consistent with geometric relationships before performing calculations.

Conclusion

Calculating the area of a regular hexagon with given side length and apothem involves understanding the fundamental geometric relationships and applying the appropriate formulas. In our case, with a side length of 10 centimeters and an apothem of $5\sqrt{3}$ centimeters, the area is exactly $75\sqrt{3}$ square centimeters, approximately 129.9 square centimeters. Mastery of these concepts enables precise measurements and calculations essential across various scientific and practical fields.

If you encounter different values or need to work with other regular polygons, similar principles and formulas can be adapted to suit those shapes. Always verify the consistency of your data and understand the relationships between the shape's components to ensure accurate results.

Frequently Asked Questions

What is the formula to find the area of a regular hexagon when given the side length and apothem?

The area of a regular hexagon can be calculated using the formula: Area = (1/2) × Perimeter × Apothem. Since the perimeter is 6 times the side length, it becomes: Area = (1/2) × 6 × side length × apothem = 3 × side length × apothem.

Given a regular hexagon with a side length of 10 cm and an apothem of 5√3 cm, what is its area?

Using the formula: Area = 3 × side length × apothem = 3 × 10 cm × 5√3 cm = 30 × 5√3 = 150√3 cm^2, which is approximately 259.81 cm^2.

How do you verify the apothem length in a regular hexagon with a side of 10 cm?

In a regular hexagon, the apothem is equal to (side length) × (√3)/2. For a side of 10 cm, apothem = 10 × (√3)/2 = 5√3 cm, matching the given apothem length.

If the apothem of a regular hexagon is 5√3 cm and the side length is 10 cm, how do the two relate geometrically?

In a regular hexagon, the apothem is the distance from the center to the middle of a side, and it relates to the side length via the formula: apothem = (side length) × (√3)/2. Here, 10 × (√3)/2 = 5√3 cm, confirming their relationship.

What is the significance of the apothem in calculating the area of a regular hexagon?

The apothem acts as the height of each of the six equilateral triangles that compose the hexagon, making it essential for calculating the total area using the formula: Area = (1/2) × Perimeter × Apothem.

Can the area of a regular hexagon be calculated solely from its side length? Why or why not?

Yes, because in a regular hexagon, the apothem can be derived from the side length using geometric relationships, allowing the area to be calculated solely from the side length with the formula: Area = $(3\sqrt{3}/2) \times \text{side length}^2$.

What is the approximate numerical value of the area of the hexagon with side 10 cm and apothem $5\sqrt{3}$ cm?

The approximate area is $150\sqrt{3}\ \text{cm}^2 \approx 259.81\ \text{cm}^2$.

How does changing the side length affect the area of a regular hexagon?

The area of a regular hexagon is proportional to the square of its side length. Increasing the side length increases the area quadratically, as given by the formula: Area = $(3\sqrt{3}/2) \times \text{side length}^2$.

Is the given apothem of $5\sqrt{3}$ cm consistent with a side length of 10 cm? How do you confirm?

Yes, it is consistent because the apothem in a regular hexagon is calculated as (side length) × $(\sqrt{3})/2$. For a side length of 10 cm, apothem = $10 \times (\sqrt{3})/2 = 5\sqrt{3}$ cm, confirming the values are correct.

Additional Resources

Find The Area Of A Regular Hexagon With A Said Length Of 10 Centimeters And An Apothem Of 5 Square Root

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Introduction

The study of regular hexagons often captures interest not only among students but also among professionals in fields such as architecture, engineering, and design. Their unique geometric properties lend themselves to practical applications, from tiling patterns to structural frameworks. A common challenge posed in geometric problem-solving involves determining the area of a regular hexagon when certain parameters—such as side length and apothem—are provided.

In this article, we deeply investigate the problem: Find the area of a regular hexagon with a said length of 10 centimeters and an apothem of 5 square root centimeters. While the problem statement appears straightforward, it invites a nuanced exploration of the underlying geometry, the relationships between side length and apothem, and the correct interpretation of the given data. We will analyze the problem step-by-step, clarify potential ambiguities, and present a comprehensive solution grounded in geometric principles.

Understanding the Geometry of a Regular Hexagon

Fundamental Properties

A regular hexagon is a polygon with six equal sides and six equal interior angles. Its symmetry and uniformity give rise to specific, well-defined relationships among its dimensions:

- Side length (s): The length of each side.
- Apothem (a): The perpendicular distance from the center to any side.
- Radius (r): The distance from the center to any vertex.

Relationships Among Dimensions

For a regular hexagon, these key relationships hold:

- The radius (r) equals the side length:
$$ r = s $$
- The apothem (a) relates to the side length as:
$$ a = \frac{\sqrt{3}}{2} \times s $$
- The area (A) can be calculated using the apothem:
$$ A = \frac{1}{2} \times \text{Perimeter} \times a $$

Given these properties, the problem reduces to verifying the consistency of the provided dimensions and computing the area accordingly.

Interpreting the Provided Data

The problem states:

- Side length: 10 centimeters
- Apothem: 5 square root (cm), which appears to be incomplete or ambiguously phrased.

Potential Clarifications:

1. "A Said Length of 10 centimeters" — interpreted as the side length $s = 10\,\text{cm}$.

2. "An Apothem of 5 Square Root" — likely intended as "of 5√cm" or "5√(something) cm".

Given the standard notation, it's probable that the apothem is $5\sqrt{3}$ centimeters, since this value aligns with the properties of a regular hexagon with side length 10 cm:

$$
a = \frac{\sqrt{3}}{2} \times s = \frac{\sqrt{3}}{2} \times 10 = 5 \sqrt{3} \approx 8.6603\, \text{cm}
$$

But the problem states the apothem is 5√ (possibly $5\sqrt{3}$) centimeters, or perhaps $5\sqrt{1}$ (which is 5).

Confirming Consistency of Dimensions

Let's verify which value aligns with the standard relationships:

- If $a = 5\sqrt{3}$ cm, then:

$$
a = 5 \sqrt{3} \approx 8.6603\, \text{cm}
$$

- The side length is 10 cm, which matches the relation:

$$
a = \frac{\sqrt{3}}{2} \times s = \frac{\sqrt{3}}{2} \times 10 = 5 \sqrt{3}
$$

This confirms that if the apothem is $5\sqrt{3}$ cm, it matches the standard geometric relationship for a regular hexagon with side length 10 cm.

Therefore, the most consistent interpretation is:

- Side length $s = 10\, \text{cm}$
- Apothem $a = 5 \sqrt{3}\, \text{cm}$

Calculating the Area of the Hexagon

With the clarified data, the steps to find the area are as follows:

Step 1: Recall the Area Formula

The area A of a regular hexagon can be computed via:

$$
A = \frac{1}{2} \times \text{Perimeter} \times a
$$

Where:

- Perimeter $P = 6 \times s$
- Apothem a as given.

Step 2: Calculate the Perimeter

$$
P = 6 \times 10\, \text{cm} = 60\, \text{cm}
$$

Step 3: Apply the Area Formula

$$
A = \frac{1}{2} \times 60\, \text{cm} \times 5 \sqrt{3}\, \text{cm}
$$

$$
A = 30 \times 5 \sqrt{3}\, \text{cm}^2
$$

$$
A = 150 \sqrt{3}\, \text{cm}^2
$$

Numerically, this becomes:

$$
A \approx 150 \times 1.732 = 259.8\, \text{cm}^2
$$

Alternative Approach: Using the Side Length to Compute the Area

Another well-known formula for the area of a regular hexagon is:

$$
A = \frac{3 \sqrt{3}}{2} \times s^2
$$

Substituting $s = 10\, \text{cm}$:

$$
A = \frac{3 \sqrt{3}}{2} \times 100 = \frac{300 \sqrt{3}}{2} = 150 \sqrt{3}\, \text{cm}^2
$$

This matches our previous result, confirming consistency.

Deep Dive: The Relationship Between Side Length and Apothem

Understanding the geometric relationship is crucial:

$$
a = \frac{\sqrt{3}}{2} \times s
$$

- For $s = 10\, \text{cm}$:

$$
a = \frac{\sqrt{3}}{2} \times 10 = 5 \sqrt{3}\, \text{cm}
$$

- If the apothem is given as $5\sqrt{3}$ cm, it directly confirms the side length.

Implications:

- The problem's initial ambiguity underscores the importance of precise notation.
- The geometric relationships act as consistency checks, ensuring the provided dimensions align with the properties of a regular hexagon.

Additional Insights and Applications

Significance of the Apothem in Area Calculation

The apothem is not only a measure of distance from the center to a side but also a key parameter in calculating the area directly, especially in polygons with many sides:

$$
A = \frac{1}{2} \times \text{Perimeter} \times a
$$

In architectural design, knowing the apothem allows for efficient space planning and structural analysis.

Real-World Applications

- Tiling and Flooring: Hexagonal tiles are popular due to their efficient tessellation. Precise calculations of area aid in estimating the number of tiles needed.
- Structural Engineering: Hexagonal patterns are used in honeycomb structures, where understanding dimensions impacts strength and material optimization.
- Design and Art: Geometric patterns often employ regular hexagons; accurate area calculations inform proportionality and aesthetics.

Summary of Findings

Parameter	Value	Explanation
Side length s	10 cm	Given in the problem statement
Apothem a	$5 \sqrt{3}$ cm	Derived from the relation $a = \frac{\sqrt{3}}{2} \times s$
Perimeter P	60 cm	$6 \times s$
Area A	$150 \sqrt{3}$ cm^2	Using the formula $A = \frac{1}{2} \times P \times a$

Final Remarks

The investigation reveals that the problem, while seemingly straightforward, hinges on correctly interpreting the given dimensions. When the side length is 10 centimeters and the apothem is $5 \sqrt{3}$ centimeters, the area of the hexagon computes to approximately 259.8 square centimeters.

This exploration underscores the importance of understanding the relationships among geometric parameters and highlights how precise notation and consistent data interpretation are vital in mathematical problem-solving. Whether for academic purposes, engineering design, or artistic projects, the principles elucidated here serve as foundational tools for engaging with hexagonal geometries.

References

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- Weisstein, E. W. (n.d.). "Hexagon." MathWorld. Retrieved from https://mathworld.wolfram.com/Hexagon.html
- Van Nostrand Reinhold. (2004). Geometry. McGraw-Hill Education.

Note: If the initial problem intended the apothem to be

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